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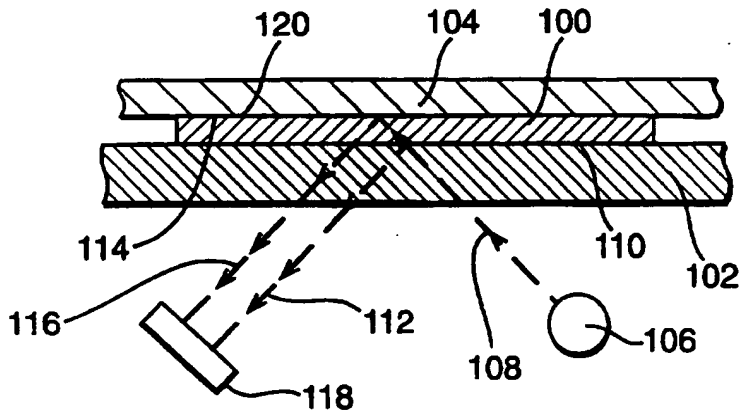
(54) Abstract Title
Reflector for document scanner

(57) A reflective surface (120) behind a document (100) to be scanned on an optical image scanner, copier, facsimile machine or similar device has a reflectance less than 90% with a preferred reflectance range of 60% to 75%. This reflective surface (120) is substantially integral with the scanner, copier or facsimile lid surface and substantially reduces image bleed-through while resulting in an acceptable level of color shift and an acceptable loss of dynamic range relative to a white surface. In a second embodiment, the reflective surface (120) is interchangeable by the end user in order to optimize the reflectance of the reflective surface (120) for any given document (100) to be scanned, copied, or faxed.

FIG. 4



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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

FIG. 1

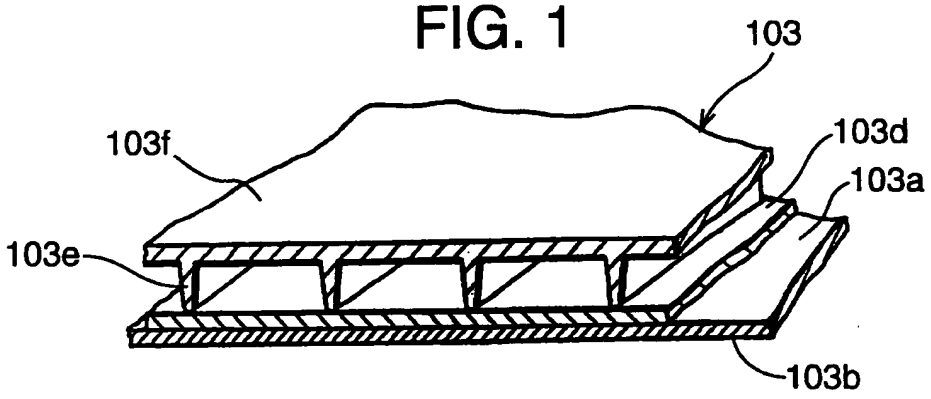


FIG. 2

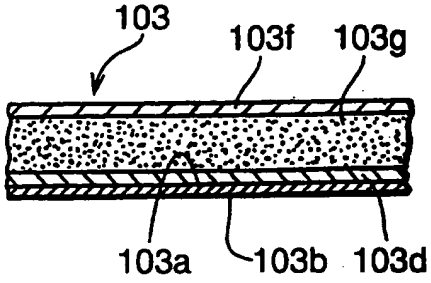


FIG. 3

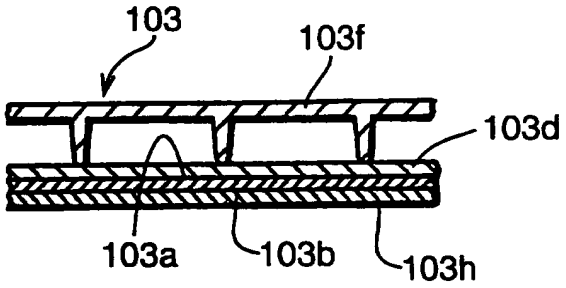


FIG. 4

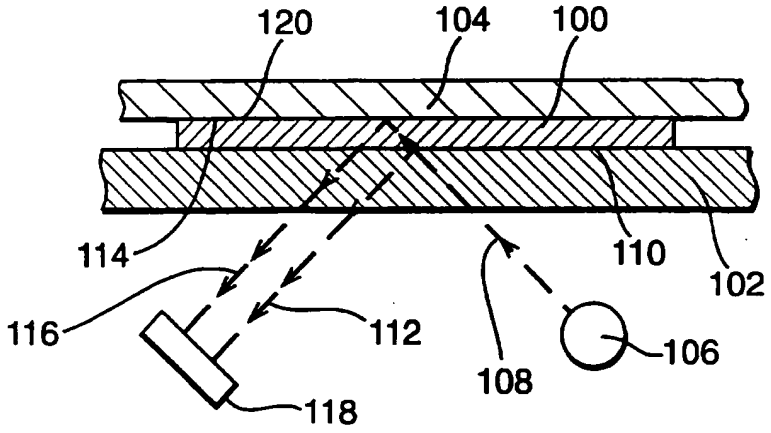


FIG. 5

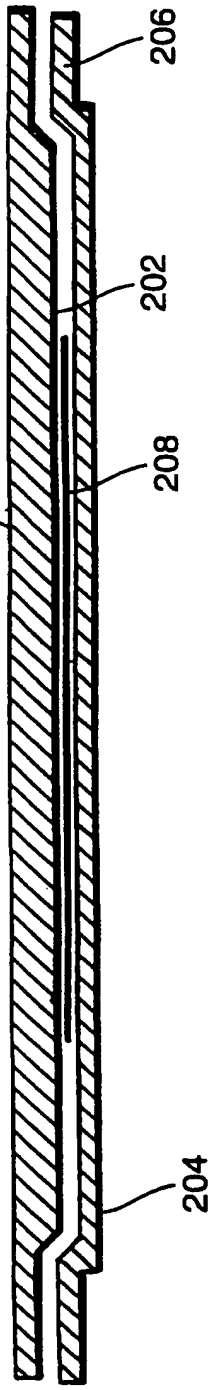
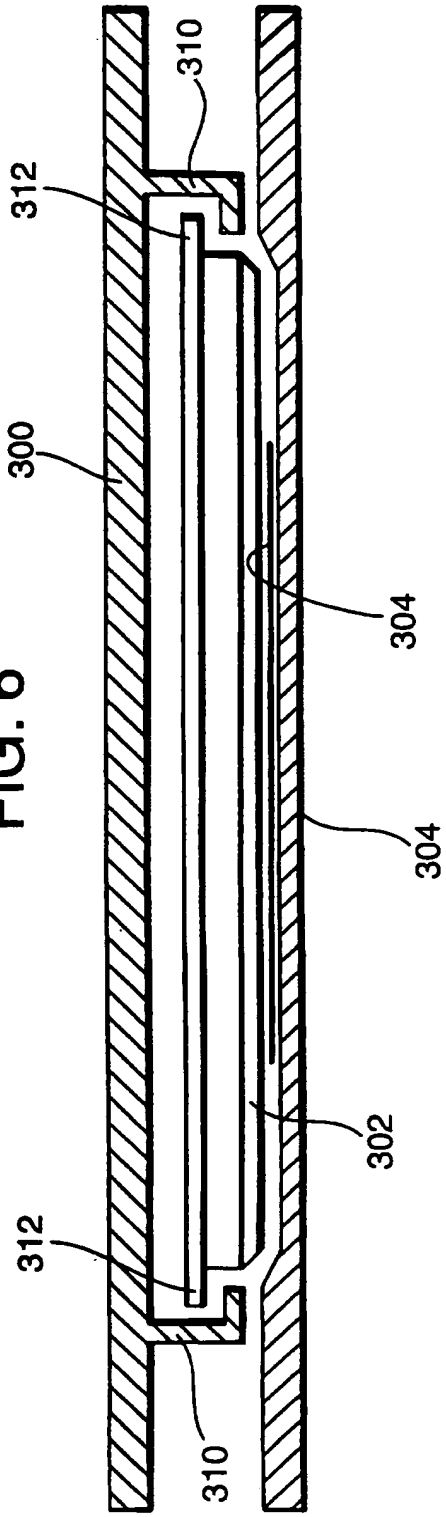


FIG. 6



REFLECTOR FOR DOCUMENT SCANNER OR COPIER

FIELD OF INVENTION

This invention relates generally to scanners, copiers, facsimile machines and other devices used for transforming an optical image of a document into a electronic signal and more specifically to a reflective surface used behind a document to be imaged.

BACKGROUND OF THE INVENTION

Electronic document scanners, copiers, and facsimile machines transform an optical image of a document into an electric signal suitable for storing, displaying, printing or electronic transmission. Documents to be scanned may generally be classified as either transparent or opaque. For opaque documents, light is reflected off an image on the surface of the document onto a photosensitive transducer, typically a photoconductive drum or an array of photosensitive sensor elements. However, documents are rarely completely opaque. In a typical device, some light passes through the document to a secondary reflective surface, for example a lid or automatic document feeder. Some light then reflects off the secondary reflective surface and passes back through the document a second time. The light that passes through the document twice may also be detected by the photosensitive transducer. If the document has an image on both sides, the image adjacent to the secondary reflective surface may be partially imaged onto the photosensitive transducer. For example, when copying double sided documents, sometimes an image on the back of the document partially appears in the resulting copy. This undesirable result is often called "bleed-through." There is a need for reduction of bleed-through in copiers, scanners, facsimile machines and similar devices.

Figure 1 shows prior art scanner cover with a reflective surface 103a on the scanner cover 103f. The reflecting surface 103a is formed by evaporating silver, chrome or aluminum onto one side of a transparent polyester film 103b. To the reflecting surface 103a, a hard plate 103d of a hard plastic material is bonded. Further, the plate 103d is supported by scanner cover 103f of a hard plastic material having reinforcing legs 103e. One possible alternative is that a metal is evaporated to the plate 103d, or that the plate 103d is made of a metal.

Figure 2 shows another prior art scanner cover and reflective surface, wherein the original cover 103 includes a covering 103f of a resin, an elastic member 103g, such as sponge, a hard plate 103d of a plastic material which is not easily deformed and a transparent polyester film 103b having a reflecting metal surface at one side thereof, which are overlaid in the order named. Since a hard plate 103d is sandwiched by the reflecting surface 103a and the resilient member 103g, the surface 103a is not deformed and can softly press the original when a three-dimensional original is placed thereunder. One alternative is that a metal is evaporated to the plate 103d, or that the plate 103d is made of metal.

Figure 3 shows another prior art scanner cover and reflective surface, wherein the layer 103b of Figure 1 is supported by a resin sheet 103h which is of transparent and flexible synthetic resin. Because of this, the possible shock or uncomfortable closed relatively strongly. In Figure 3, the reflecting surface 103a is shown as being formed between the sheet 103b and the sheet 103h, but it can be between the sheet 103b and the sheet 103d.

SUMMARY OF THE INVENTION

An improved document lid and secondary reflective surface is provided that minimizes bleed-through and other image parameters of interest, such as brightness, contrast and color shift. The document lid and secondary reflective surface also permits a cost and labor savings in the lid and permits the lid to be recycled.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates a cross section of a first scanner lid with a reflective surface according to the prior art;

Figure 2 illustrates a cross section of a second scanner lid with a reflective surface according to the prior art;

Figure 3 illustrates a cross section of a third scanner lid with a reflective surface according to the prior art;

Figure 4 illustrates a cross section of an imaging device cover including a secondary reflective surface in accordance with a first embodiment of the present invention;

Figure 5 illustrates a cross section of an imaging device cover with a reflective secondary reflective surface in accordance with a second embodiment of the present invention; and

Figure 6 illustrates a cross section of an imaging device cover with a reflective secondary reflective surface in accordance with a third embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

The figure illustrates a document 100, laying face down on a transparent platen 102, with a lid or automatic document feeder 104. The document 100 has an image on a front face 110, an perhaps a second image on a back face 120. The lid or automatic document feeder 104 provides a secondary reflective surface 114. A lamp 106 provides light rays 108. Most of the light rays 108 reflect off the front face 110 of the document 100, generating front reflected light rays 112. Some of the light rays 108 pass through the document 100, reflect off of the secondary reflective surface 114, passing through the second image on the back face 120 of the document, and back through the document 100, generating secondary reflected light rays 116. Both light rays 112 and 116 are received and transformed by a photosensitive transducer 118. Transducer 118 may be a photosensitive drum or an array of photosensitive elements or a single light beam may be scanned and reflected onto a single sensor. The figure is simplified in that scanning devices typically include lenses, mirrors and other optical components not relevant to the invention.

The secondary reflected light rays 116 are of particular concern when scanning or copying color images, where accurate (as perceived by the human visual system) color reproduction is needed. One way to eliminate secondary reflected light rays and resulting bleed-through is to make surface 114 non-reflective (black). However, a black surface may create other undesirable effects as follows. First, consider dynamic range (or contrast) of an image, which is the difference in reflectance between the darkest part of the image (sometimes called shadow) and the lightest part of the image (sometimes called highlight). Document 100 is typically paper. If light is permitted to reflect back through the light areas of an image, the light areas appear to be whiter, increasing the effective dynamic range. For an extreme example, consider an image on thin tissue paper. When viewed on a white background, the light areas of the image

will appear white. When viewed on a black background, the light areas will shift toward gray, reducing the dynamic range of the image. Second, a black background can cause a color shift. White paper typically acts as an optical filter, suppressing short wavelengths and passing long wavelengths. That is, white paper typically has a higher transmission for red and green wavelengths than for blue wavelengths. Again, using the extreme example of an image on thin tissue paper, when viewed on a white background, reds and greens appear relatively saturated and bright. When viewed on a black background, reds and greens appear less saturated. Subjectively, red tends to appear relatively dull or brick colored. Therefore, for both dynamic range and color shift reasons, a completely non-reflective surface 114 is not preferred.

In general, a secondary reflectance below about 30% may result in perceptible color shift and reduced dynamic range in typical color images on typical white paper. Preferably, the secondary reflectance should be at least 60% for subjectively acceptable color shift and dynamic range. At the other extreme, a reflectance greater than 90% may result in noticeable bleed-through on typical double-sided paper documents. A reflectance of less than 75% is desirable to reduce bleed-through. Therefore, a preferred range is reflectance in the range from 60% to 75% as an acceptable compromise, substantially reducing bleed-through but resulting in an acceptable reduction in dynamic range and an acceptable shift in perceived color.

Many commercial products are made from molded plastic in a tan or gray color that falls in the range of 60%-75% reflectance. Typically, copier lids and scanner lids have a separate white surface or are painted white. In accordance with the discussion above, in many cases it may be preferable to simply use the product plastic color with no modification, eliminating additional manufacturing cost. In addition, in scanners and other devices using arrays of charge-coupled devices, there is often a calibration strip used to measure sensor non-uniformity. The primary requirement for these calibration strips is for uniformity along the strip (and perhaps a consistent reflectivity among different strips). The cosmetic color requirements for plastic cases are often sufficient

to permit use of the plastic case with no modification as a sensor uniformity calibration strip. Therefore, an unpainted lid may also provide uniformity calibration. As stated in the background, plastic copier or scanner lids are typically manufactured by means of injection molding. Then, layers of foam, adhesive, reflective film and transparent protective films are then attached to the surface of the copier or scanner lid adjacent the object surface.

As shown in Figure 5, if the shape of the mold is modified so that the copier or scanner lid 200 is shaped to conform with the combination of the typical shape of the lid, foam, adhesive, reflective film, and transparent protective film, the plastic scanner or copier lid 200 itself may be used as the secondary reflective surface 202. The surface area of the molding tool may have to be polished, roughed, etc., in order to make sure that the secondary reflective surface 202 of the scanner or copier lid 200 is defect free and has the appropriate reflective surface. The molding tool must be reshaped so that the scanner or copier lid 200 is able to press the document 208 to be scanned or copied against the platen glass 204 of the scanner or copier. In such a case, the typical tan, gray, putty color of plastic as used in most electronic devices, computers, copiers, scanners, printers, etc. is of an appropriate color to provide reflectance in the 60%-75% range, which is found to be an acceptable compromise between bleed-through, dynamic range and perceived color.

If the plastic scanner or copier lid 200 is reformed and used as the secondary reflective surface 202, there is substantial savings in terms of parts, materials and labor in the manufacturing of the scanner or copier, especially as the typical foam/film/adhesive reflector assembly is generally complicated to align and install on the underside of the scanner or copier lid. Moreover, the scanner lid 200 according to the present invention is recyclable, as a single plastic part. Whereas, scanner lids of the prior art are generally not recyclable as the foam/film/adhesive reflector assembly is generally not removable from the scanner lid or is very expensive and labor intensive to remove. Accordingly, the scanner or copier lid with a secondary reflective

surface according to the present invention is capable of being recycled and prior art scanner or copier lids are not.

The Applicant has discovered that typically, a secondary reflective surface of substantially white is best for scanning/coping transparencies, a secondary reflective surface of substantially black is best for scanning/copier for OCR purposes, and a secondary reflective surface of substantially gray or 60-75% reflectance is best for scanning/coping color documents. Accordingly, it would be optimum for the end user to be able to change the color of the secondary reflective surface based on the document to be scanned/copied.

Figure 6 illustrates a second embodiment of the present invention including a scanner or copier lid 300 with a secondary reflective surface 302 that is able to press a document 308 to be scanned or copied against a platen glass 304 of the scanner or copier. The reflective surface 302 may be made of any color of plastic and may be slid or snapped into the scanner/copier lid 300 by means of sliding or snapping means 310 on the scanner/copier lid 300 and sliding or snapping means 312 on the reflective surface 302. Sliding/snapping means 312 and reflective surface 302 are preferably one integral part made of plastic. This embodiment of the present invention permits the end user to change the color of the reflective surface 302 by removing the current reflective surface 302 and replacing it with another reflective surface 302 of a different color.

It is relatively easy and straight forward to manufacture plastic reflective surfaces 302 of different predetermined colors to optimize the scanning/coping conditions for any given document. However, at the present time, it is believed that having reflective surfaces 302 in 3 colors (i.e., black, white, and gray/tan or putty) would meet the scanning/copying requirements for most documents. Thus, if the end user determines that he must scan or copy a transparency, he will merely slide or snap a white reflective surface 302 into the scanner/copier lid 300. If the end user determines that he needs to scan or copy a color document, he will merely slide or snap

a gray, tan, putty of like color reflective surface 302 into the scanner/copier lid 300. If the end user determines that he needs to scan or copy a document for OCR purposes, he will merely slide or snap a black reflective surface 302 into the scanner/copier lid 300.

The scanner/copier according to this embodiment of the present invention permits the optimum scanning/copying conditions for almost all documents. It reduces manufacturing costs due to parts and labor. It permits the end user to determine which reflective surfaces 302 he will need. As the reflective surfaces 302 and the scanner/copier lid 300 are made entirely of injection molded plastic, rather than the typical layers of plastic, adhesive, foam, metal/plastic film, and plastic film, both the scanner/copier lid 300 and the reflective surface are able to be recycled.

The foregoing description of the present invention has been presented for purposes of illustration and description. For example, the reflective surface may be attached to the lid by any means available, such as screws or Velcro, not merely by means of a snap or sliding fit. Although it would be preferable that the attachment means be readily removed and refitted by any end user. It is a primary concept of the present invention that the reflective surface is capable of being recycled either by itself or with the integral scanner/copier lid. The foregoing description is not intended to be exhaustive or to limit the invention to the precise form disclosed, and other modifications and variations may be possible in light of the above teachings. The embodiment was chosen and described in order to best explain the principles of the invention and its practical application to thereby enable others skilled in the art to best utilize the invention in various embodiments and various modifications as are suited to the particular use contemplated. It is intended that the appended claims be construed to include other alternative embodiments of the invention except insofar as limited by the prior art.

What is claimed is:

1. A device for electronically transforming an image into an electronic signal, the image located at a first surface, the device comprising:

an area adapted to receive a document (100, 208, 308), the document (100, 208, 308) having a first image (110) on a first side and a second image (120) on a second side, the first image (110) located at the first surface;

a reflective surface (114) adjacent to the second side of the document (100, 208, 308); and

the reflective surface (114) having a reflectance less than 90%, thereby reducing any electronic transformation of the second image (120) by the device when transforming the first image (110).

2. The device of claim 1, the reflective surface (114) having a reflectance less than 75%.

3. The device of claim 2, the reflective surface (114) having a reflectance greater than 60%.

4. An image processing device for transforming an image into an electronic signal, said image processing device comprising:

a surface (204) for supporting an original (208);

a lid (200) for covering a back side of the original (208) supported on the surface of said supporting surface (204), said lid (200) having a light reflecting surface (202), opposed to the supporting surface (204), said reflecting surface (202) being of the same material and integral with said lid (200);

a light source for illuminating the original (208) supported on the support surface (204);

photodetector for producing an electric signal in response to light reflected by the original (208); and

means for processing said electric signal produced by said photodetector.

5. The image processing device according to claim 4, wherein said reflective surface (202) has a reflectance not less than 60% and not more than 75%

6.An image processing device for transforming an image into an electronic signal, said image processing device comprising:

a surface (304) for supporting an original document (308);

a lid (300) for covering a back side of the original document (308) supported on the surface (304) of said supporting member, said lid (300) having a light reflecting surface (302) opposed to the supporting surface (304), said reflecting surface (302) being of the same material as said lid (300), said light reflecting surface (302) capable of being easily removed and replaced by a user of said image processing device, such that said user is able to interchange reflecting surfaces (302) of varying reflectance in said lid (300), so that the reflecting surface (302) may be changed to optimize the reflectance of the reflecting surface (302) for any original document (308) to be processed by said image processing device;

a light source for illuminating the original document (308) supported on the support surface (304);

photodetector for producing an electric signal in response to light reflected by the original document (308); and

means for processing said electric signal produced by said photodetector.

7. The image processing device according to claim 6, wherein said reflecting surface (302) and said lid (300) are made of plastic.

8. The image processing device according to claim 7, wherein said reflecting surface (302) is capable of being snapped into said lid (300).

9. The image processing device according to claim 7, wherein said reflecting surface (302) is capable of being slid into and out of said lid (300).

The Patent Office

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INVESTOR IN PEOPLE

Application No: GB 9902097.6 **Examiner:** John Donaldson
Claims searched: 1 to 9 **Date of search:** 25 May 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): H4F(FCA)

Int Cl (Ed.6): H04N 1/00, 1/024, 1/028, 1/03, 1/04, 1/10, 1/46, 1/48

Other: Online:WPI, EPODOC

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X, P	US 5790211	(SEACHMAN), see column 3, lines 9 to 63, column 4, lines 58 to 65, column 5, line 62 to column 6, line 20	1 to 3
X	US 5574542	(BROOK), see column 1, lines 15 to 18, column 2, line 8 to column 3, line 27	1 to 3
X	US 4455577	(TOKUHARA), see column 3, lines 3 to 32	1 to 3

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.